Avian Species Monitoring on the Nez Perce – Clearwater National Forest

2018 Final Report

White-headed Woodpecker Route WHWO-69, Red River Area. Photo: Kara Snow, May 31, 2018

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INTERMOUNTAIN BIRD OBSERVATORY

Introduction

The USDA Forest Service identifies management indicator species (MIS) as indicators of forest health (Landres et al. 1988). These species are often chosen to represent specific habitat types within the forest and, to be most effective as indicators, tend to be sensitive to changes within the forest. The Nez Perce - Clearwater National Forest (NPCNF) has a number of identified management indicator species (Dinkins et al. DRAFT). Additionally, the USDA Forest Service has an obligation to manage threatened, endangered, and sensitive species (USDA Forest Service 2011). Sensitive species are formally classified by the Forest Service as species that require special management to enhance their population to prevent a need for listing as threatened or endangered (USDA Forest Service 2011).

Beginning in 2016, through a partnership with the Nez Perce-Clearwater National Forest (NPCNF), the Intermountain Bird Observatory (IBO) began surveying for avian Management Indicator and Sensitive Species within the forest. Our efforts in 2016 focused on five species including three management indicator species – Northern Goshawk (*Accipiter gentilis*), Belted Kingfishers (*Megaceryle alcyon*), and Pileated Woodpecker (*Dryocopus pileatus*) – and two other sensitive species – White-headed Woodpecker (*Picoides albolarvatus*) and Mountain Quail (*Oreortyx pictus*). The Belted Kingfisher efforts were dropped in 2017, focusing instead on increased effort on the remaining four species. In 2018, we replaced the Mountain Quail survey with a survey for another sensitive species, the Flammulated Owl (*Psiloscops flammeolus*). This document presents the findings of the 2018 effort.

Common Methods

For all four species (White-headed and Pileated Woodpeckers, Flammulated Owls, and Northern Goshawks) we utilized a common set of methods based upon spatially-balanced random sampling. The results of the random sampling are used for all statistical inference. At the request of the NPCNF we also checked and surveyed a select group of historical Northern Goshawk territories.

Survey Site Selection

For each of the four species' random surveys, we first created species-specific strata to be sampled. The strata definitions have changed over the years as we have adjusted to increase our survey efficiency. In 2017 we decreased the stratum for White-headed Woodpeckers and increased the stratum for Pileated Woodpecker. The result is that we expected the measured occupancy rates within the strata to be higher in 2017 and 2018 for White-headed Woodpecker, and equal or slightly lower for Pileated Woodpeckers. The stratum for Northern Goshawk remained unchanged among the years, thus we expect no changes in occupancy rates for goshawks.

Within each stratum, we performed a spatially-balanced draw of 1-km by 1-km square grids using a generalized random-tessellation stratified (GRTS) design (Stevens Jr. and Olsen 2004). This protocol generated a prioritized list of spatially balanced 1-km × 1-km survey grids that enabled individual grids to be dropped from the survey while still maintaining a balanced design. The balanced design holds true as long as grids are not systematically removed, which can introduce a systematic bias.

We manually evaluated each proposed survey grid, removing grids located on private land (more than 1/3 private), and grids that required a hike of greater than four miles from the nearest access point. These filters introduced a systematic bias in the results favoring grids on public land and with reasonable access. This bias was considered acceptable given cost/benefit concerns. Within each 1-km grid square, we placed nine survey points 333m apart and 166m from the edge of the grid (Fig. 1).

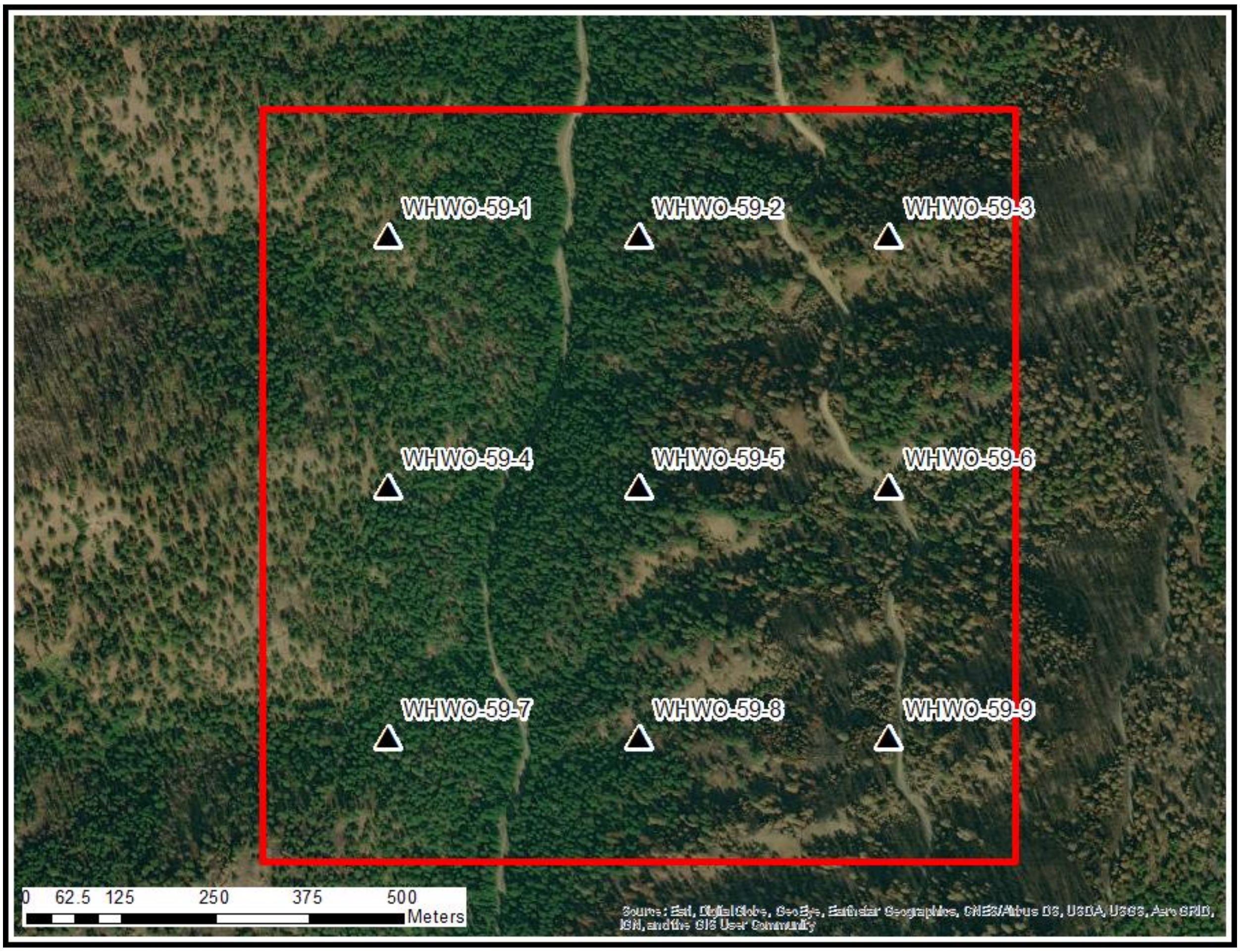

Figure 1. Example illustrating nine survey points, each separated by 333m, within a 1-km square sampling grid.

Field Surveys

With the exception of early season training for the team, we surveyed each woodpecker and goshawk grid by a single individual, whereas we surveyed for Flammulated Owls in teams of two (for safety). For woodpecker surveys, we began 15 minutes prior to local sunrise and completed within five hours after local sunrise. For Flammulated Owl surveys we began 30 minutes after local sunset and completed by 2:00am. The Northern Goshawk surveys had no such time constraint. Each surveyor(s) completed as many of the nine survey points within the grid that could be safely accessed and completed within the designated survey period. At each survey point, the surveyor completed the observation period specific to the species, and documented the habitat composition surrounding the point. For Flammulated Owls, we visited each point before sunset to document the habitat surrounding the point (often splitting up in two teams of one surveyor), and then returned after sunset to complete the broadcast survey (in teams of two for safety).

For woodpeckers and Flammulated Owls we utilized the habitat collection protocol from the Integrated Monitoring in Bird Conservation Regions (IMBCR) program (Hanni et al. 2013). The IMBCR protocol specifies the collection of canopy, mid-story, and ground cover composition within a 50m radius of the survey point. We augmented this protocol with a more specific snag quantification protocol that we developed. At each survey point we recorded the distance to the nearest 15 snags visible from the point using a laser rangefinder. Additionally, we estimated species, diameter at breast height [DBH], snag height, percent bark, and the number of visible cavities for each snag.

Multi-scale Occupancy Analysis

All analyses include a combination of surveyor-collected habitat data and data extracted from GIS sources such as digital elevation models (DEMs) and Forest Service Inventory layers (e.g., VMap vegetation layer; Brown and Ahl 2011). We performed multi-scale occupancy modeling as the primary analysis method (Nichols et al. 2008, Pavlacky Jr. et al. 2012). For most species, we implemented an interval-by-interval replacement design (two-minute intervals for Flammulated Owl and Northern Goshawk, one-minute intervals for woodpeckers), allowing for simultaneous evaluation of detection, point-scale occupancy, and transect-scale occupancy (Nichols et al. 2008). For Northern Goshawk surveys, we used a removal design instead of a replacement design to minimize the length of disturbance to nesting goshawks (i.e., we ceased broadcasts after a detection). Similar to Pavlacky et al. (2012) we used a modified version of Nichols et al. (2008) where the point-scale occupancy uses spatial replicates. Northern Goshawk surveys included only broadcast protocols, whereas Flammulated Owl and woodpecker surveys included a combination of silent and call broadcast periods.

We evaluated day-of-year, time-of-day, cloud cover, and wind speed as covariates influencing the probability of detection in all models. In multi-scale occupancy models, the probability of detection is the probability of detecting at least one bird of interest at a point given that at least one of the birds of interest was available at the point during the survey (p). We generated three estimated densities of snags near the points – all snags, medium and larger snags (>6 inch DBH), and large snags (>16 inch DBH). We used distance sampling to generate an estimate of snag density for each sampled survey grid (Buckland et al. 2004). We evaluated each of the three snag densities within the model selection, but never in the same model. Only the top-ranking snag density size class was propagated through the model selection process.

We evaluated many landscape and habitat variables (including our snag density estimates) as predictors of a point being occupied by at least one bird of interest given that at least one bird of interest was occupying the transect (Θ). Transect-scale landscape and habitat variables were evaluated for influencing the presence of at least one bird of interest on the transect (Ψ). Due to our limited sample size of detections with some programs (e.g., White-headed Woodpeckers), we were not always able to evaluate covariates predicting overall transect occupancy (Ψ) for these species, however, within this modelling approach, point-scale occupancy (Θ) can be used as a surrogate as far as habitat preferences are concerned (Pavlacky et al. 2012).

We ranked occupancy models using Akaike Information Criterion adjusted for small sample size (AIC_c; Burnham and Anderson 2002). We first selected candidate variables influencing the probability of detection (p) by considering all combinations of the variables and chose all variables appearing in models within two ΔAIC_c of the top model. We then fixed the variable set for probability of detection and repeated the procedure for variables influencing the occupancy at the point-scale (Θ). If we had sufficient sample size, we also evaluated variables influencing transect occupancy (Ψ).

For inference, we used model averaging of all models falling within two ΔAIC_c of the top model, that also ranked higher than the null model (Burnham and Anderson 2002). For each variable appearing within this final model set, we created and present model-averaged predictions by ranging the variable of interest over its measured range while holding all other variables at their mean value.

Maximum Entropy (MaxEnt) Modeling

New in 2017 we added MaxEnt analysis for each of the evaluated species to produce a more flexible estimated distribution map. We continued this effort in 2018. We started by producing study-wide raster maps for elevation, slope, roughness, canopy cover, and an ecological relevant sample of the 19 standard climate variables derived from 1970 – 2000 (worldclim.org; Fick and Hijmans 2017; Table 1). Roughness was calculated from the 30m digital elevation model and represents the difference between the maximum and the minimum value of a cell and its 8 surrounding cells. The climate variables are included as a proxy for habitat on a scale where we lacked specific plant composition data broadly on the landscape. All geographic values (elevation, slope, roughness) were resampled down to 30-second blocks (~1km; resolution of the climate data) using bilinear interpolation.

We used all presence and pseudo-absence observations (locations that we failed to detect the species of interest, but cannot be certain that they were absent) from 2016, 2017, and 2018 to build the models. We evaluated the MaxEnt model feature classes (linear, quadratic, hinge) and regularization parameters (0.5 – 4.0) using AIC_c (Shcheglovitova and Anderson 2013).

Table 1. Climate, geographic, and habitat variables and source of variables included in MaxEnt analysis.

Variable	Source
Annual Mean Temperature (°C)	worldclim.org bio_1
Mean Diurnal Range (Mean of monthly (max temp - min temp)) (°C)	worldclim.org bio_2
Isothermality (BIO2/BIO7) (* 100)	worldclim.org bio_3
Temperature Seasonality (standard deviation *100)	worldclim.org bio_4
Max Temperature of Warmest Month (°C)	worldclim.org bio_5
Min Temperature of Coldest Month (°C)	worldclim.org bio_6
Temperature Annual Range (BIO5-BIO6) (°C)	worldclim.org bio_7
Mean Temperature of Wettest Quarter (°C)	worldclim.org bio_8
Mean Temperature of Driest Quarter (°C)	worldclim.org bio_9
Mean Temperature of Warmest Quarter (°C)	worldclim.org bio_10
Mean Temperature of Coldest Quarter (°C)	worldclim.org bio_11
Annual Precipitation (mm)	worldclim.org bio_12
Precipitation of Wettest Month (mm)	worldclim.org bio_13
Precipitation of Driest Month (mm)	worldclim.org bio_14
Precipitation Seasonality (Coefficient of Variation)	worldclim.org bio_15
Precipitation of Wettest Quarter (mm)	worldclim.org bio_16
Precipitation of Driest Quarter (mm)	worldclim.org bio_17
Precipitation of Warmest Quarter (mm)	worldclim.org bio_18
Precipitation of Coldest Quarter (mm)	worldclim.org bio_19
Elevation (m)	USGS DEM
Slope	USGS DEM
Roughness	USGS DEM
Canopy Cover	NLCD 2011
Tree Size	VMap

Analysis Software

We conducted all statistical analyses in Program R and Program Mark (White and Burnham 1999, R Core Team 2017). We used the R package “RMark” to interface between Program R and Program Mark for the multi-scale occupancy modeling (Laake 2014). We used R package “AICcmodavg” to rank all multi-scale occupancy models (calculating AIC_c), and to perform model averaging (Mazerolle 2015). We used R package “dismo” (Hijmans et al. 2017), interfacing with the MaxEnt software engine (Phillips et al. 2017), for all MaxEnt analysis. We used R package “ENMeval” for ranking and evaluating MaxEnt models (Muscarella et al. 2014).

White-headed and Pileated Woodpeckers

We performed surveys for both White-headed and Pileated Woodpeckers across the White-headed Woodpecker stratum. In 2018 we dropped the Pileated Woodpecker stratum surveyed in previous years. The White-headed Woodpecker stratum (WHWO stratum) was about ½ size of the 2016 WHWO stratum and the same as the 2017 WHWO stratum.

White-headed Woodpecker

The WHWO stratum was based loosely upon habitat suitability models developed elsewhere (Latif et al. 2015), with some attributes relaxed to fit the expected NPCNF characteristics (e.g., low slope removed as a factor) and extended into areas where they may exist in low densities and may have gone undetected. The WHWO stratum was reduced in size from 2016 to focus on higher quality habitat. Published habitat suitability models emphasize the importance of ponderosa pine, but do not require it if all other attributes are favorable (Latif et al. 2015). To focus on the highest quality habitat, we restricted the 2017 and 2018 stratum to only areas with a considerable presence of ponderosa pine. Additionally, the WHWO stratum consisted of areas with high canopy cover, and with areas of low canopy cover within 300m (clearings). One-kilometer square grids including at least 70% of this habitat type were included in the WHWO stratum.

At all woodpecker survey grids, regardless of stratum, we performed the same survey protocol consisting of six minutes of silent listening and then two-minute broadcast/silent for each of the two species (ten minutes total time per point). For each species, we omitted detections that only occurred during the playback of the other species (eight minutes total, six silent minutes, two broadcast minutes, per species). In 2018 we omitted a single White-headed Woodpecker detection that was only detected during the Pileated Woodpecker broadcasts. This bird was omitted from the occupancy models, but not the MaxEnt models.

Woodpecker habitat in the Allison Creek area. Photo: Josie Braun, May 4, 2018.

We completed 404 survey points located in 56 survey grids (1km × 1km). White-headed Woodpeckers were detected on survey at eight points within five of the 56 survey grids (Fig. 2). White-headed Woodpeckers were also observed on two other grids, but not during the formal survey (Table 2).

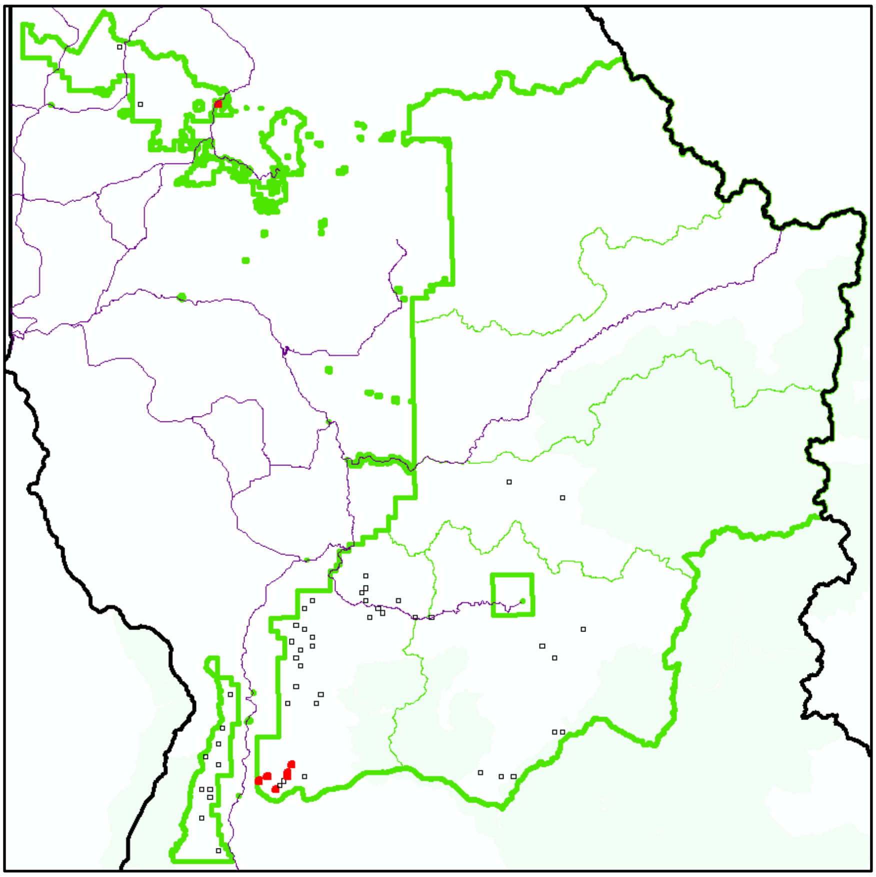

Figure 2. Completed woodpecker surveys within the Nez Perce - Clearwater National Forest during the 2018 Survey Season. Surveys without White-headed Woodpecker detections illustrated by open boxes, surveys with White-headed Woodpecker detections in red.

Table 2. Observations of White-headed Woodpeckers during 2018 survey efforts and incidental observations of White-headed Woodpeckers made between surveys. All coordinates in NAD83 datum.

Route, Point	Date	UTM Zone	UTM Northing	UTM Easting
WHWO-48,7	5/18/2018	11N	5197167	547167
WHWO-59,4	5/3/2018	11N	5036500	565167
WHWO-68,1	5/4/2018	11N	5034833	564167
WHWO-68,1	5/4/2018	11N	5034833	564167
WHWO-68,5	5/4/2018	11N	5034500	564500
WHWO-93,3	6/20/2018	11N	5033833	559833
WHWO-98,2	6/20/2018	11N	5032833	557500
WHWO-98,3	6/20/2018	11N	5032833	557833
WHWO-98,5	6/20/2018	11N	5032500	557500
Incidental	5/3/2018	11N	5030132	545501
Incidental		11N	5031004	563095

Consistent with the results of other studies, the probability of detecting a White-headed Woodpecker at a point given that one was present, was much higher during the broadcast portion of the survey (Fig. 3). The probability of detection increased from 0.09 during the silent period to 0.58 during the broadcast.

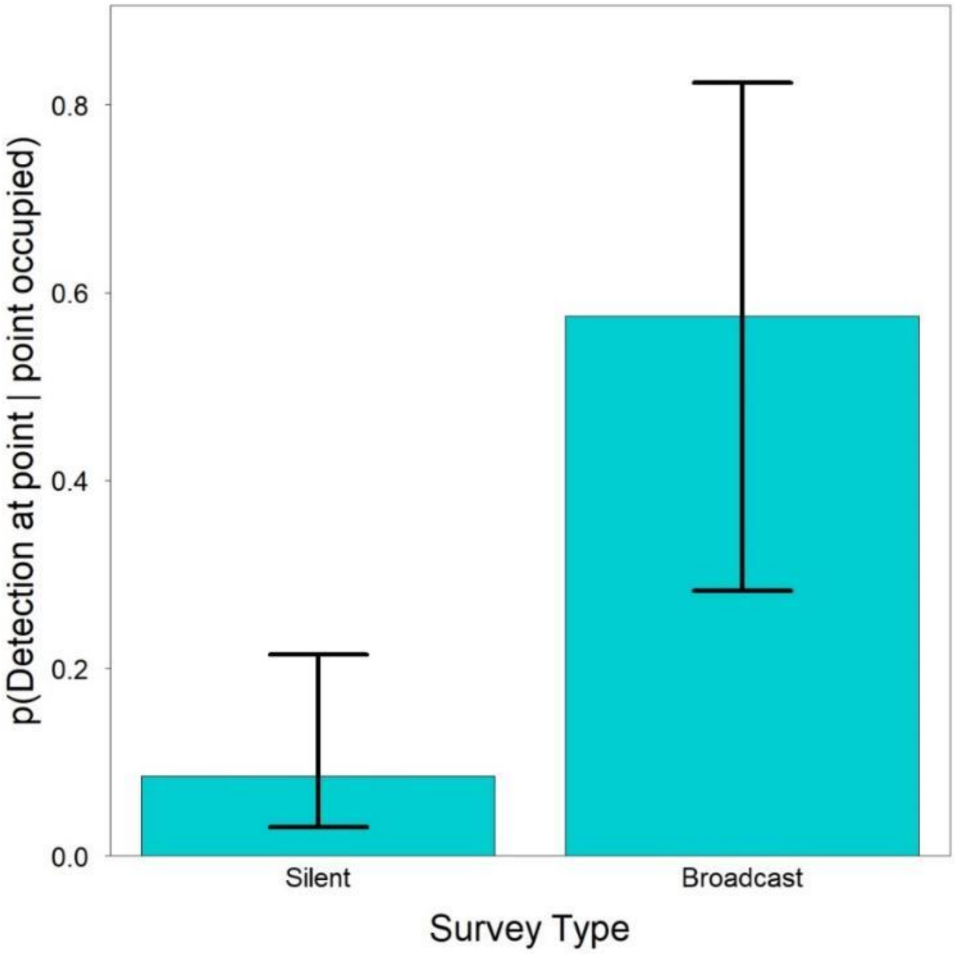

Figure 3. Covariates influencing the probability of detecting at least one White-headed Woodpecker at a point given that there was at least one White-headed Woodpecker at the point (p), represented with 95% confidence intervals.

Consistent with our past two years of results, White-headed Woodpeckers were more likely to be found in areas with higher proportion of ponderosa pine present relative to other tree species (Fig. 4). Given that there was at least one White-headed Woodpecker on the survey grid, the probability of them occupying a given point increased from 0.03 when there was no ponderosa pine within 50m of the point to 0.32 when the habitat surrounding the point was 100% ponderosa pine. This finding is consistent with all previous literature (e.g., Garrett et al. 1996, Latif et al. 2015).

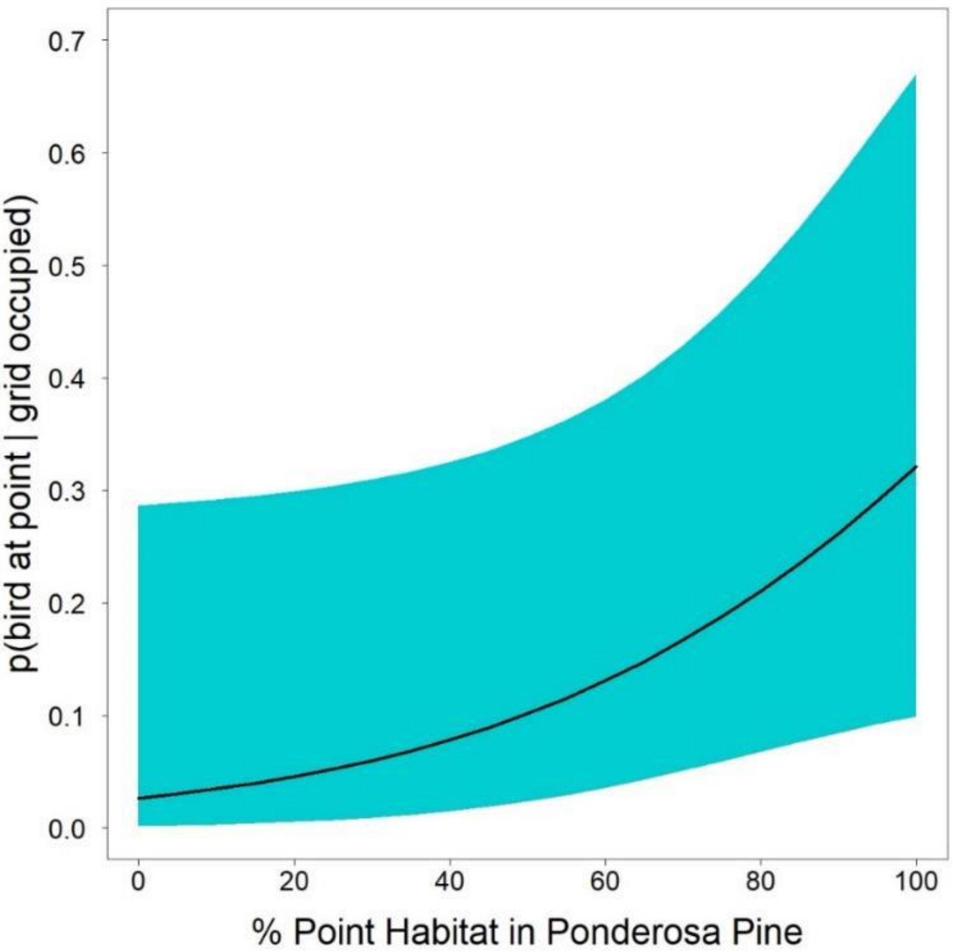

Figure 4. Covariates representing canopy cover and the percentage of local forest habitat composed of ponderosa pine at a point predicting occupancy of the point by at least one White-headed Woodpecker given that at least one White-headed Woodpecker occupies the survey grid (Θ), represented with 95% confidence intervals.

This year we did not find an association with canopy cover. The previous two years we found a negative association with high canopy cover. Previous studies (e.g., Latif et al. 2015) have found an association of White-headed Woodpeckers with higher canopy cover. However, their study focused on the nest location, whereas, our results only represent survey locations. Latif et al. (2015) found that White-headed Woodpeckers prefer areas with higher canopy cover for nesting, but also prefer low canopy cover nearby (i.e., clearings), thus the overall canopy cover preference of an area may be lower than what is overall available in the forest. It's possible that our inconsistent findings on canopy cover are the result of this dichotomous preference.

Lastly, we found that White-headed Woodpeckers had a strong association with the number of snags present in the survey area (Fig. 5). White-headed Woodpeckers were found more often in survey grid where there was a high density of snags. In previous years, the number of large snags was chosen as the predictor, but in 2018 the number of all snags barely edged out the density of large snags as the favored predictor. As these are correlated variables, it is not too surprising that sampling variance could cause a switch between variables in a given year, especially with such as small sample size. The association with snags for this species, and most woodpecker species, is to be expected.

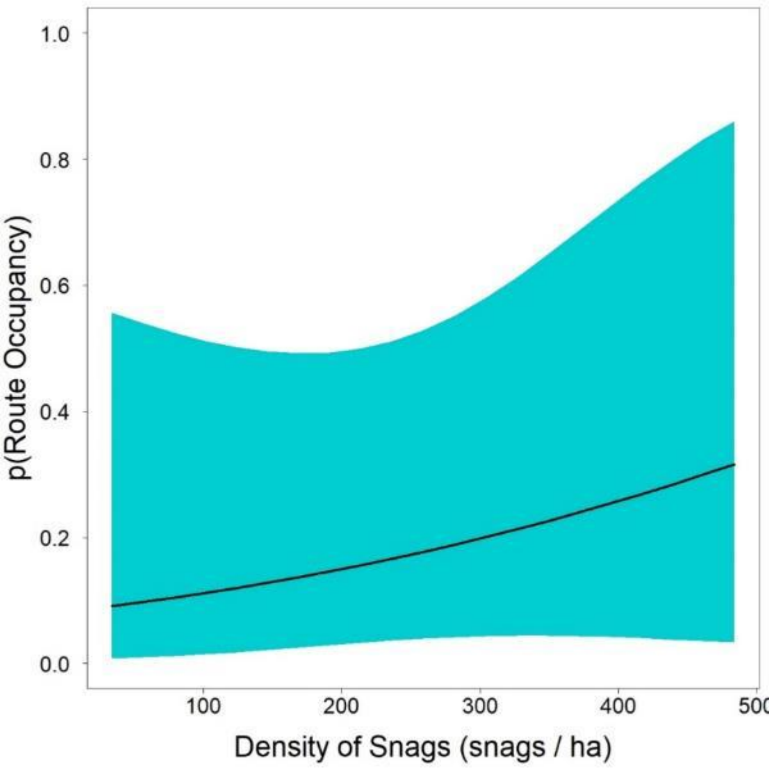

Figure 5. Covariate representing the density of snags on the predicted occupancy of the grid by White-headed Woodpeckers (Ψ), represented with 95% confidence intervals.

Using the top model, we calculated the probability of detecting a White-headed Woodpecker given that one was present (*p*) without call broadcast to be 0.09 ± 0.04 [95% CI: 0.03 – 0.21], and with call broadcast to be 0.58 ± 0.15 [95% CI: 0.28 – 0.83]. We calculated point-scale occupancy (i.e., availability; *Θ*) to be 0.06 ± 0.06 [95% CI: 0.01 – 0.32]. We calculated overall transect-scale occupancy within the WHWO stratum (*Ψ*) to be 0.14 ± 0.10 [95% CI: 0.04 – 0.43]. The probability of encountering a White-headed Woodpecker within ponderosa pine ($\Theta \times \Psi$) is 0.01. The calculated rate of occupancy showed a non-significant decreased between 2017 and 2018 (Fig. 6). As these estimates are well within the confidence intervals, this potential decrease may be an anomaly, but justifies continued exploration.

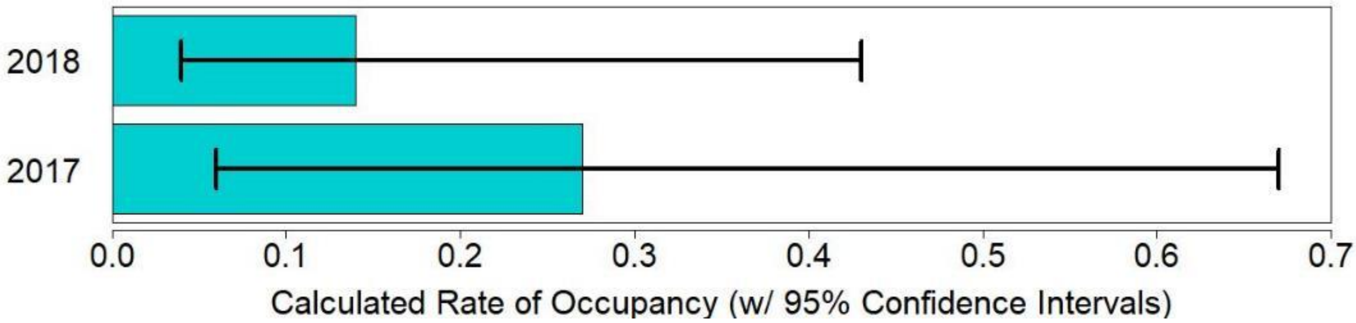

Figure 6. Calculated rate of 1km × 1km grid occupancy by White-headed Woodpeckers among years within the White-headed Woodpecker survey stratum, each illustrated with 95% confidence intervals.

In building the MaxEnt model for White-headed Woodpecker, the regularized training gain for the best fitting model (Linear/Quadratic with regularization parameter 1.0) built with all presence/pseudo-absence records from 2016, 2017, and 2018 combined was 0.83, and the Area Under the Curve of the receiver operating characteristic plot (AUC) was 0.86. This represents a very good fit. From the jackknife test of variable importance, the single most important predictor variable, in terms of the gain produced by a one-variable model, was Roughness (+), followed by Slope (+), Mean Temperature in Coldest Quarter (+), and Minimum Temperature of the Coldest Month (+). Isothermality (+), followed by Precipitation in Warmest Quarter (-), Slope (+), and Mean Temperature in Coldest Quarter (+), decreased the gain the most when they were omitted from the full model, which suggests they contained the most predictive information not present in the other variables.

The MaxEnt model predictions for White-headed Woodpecker, built from the three years combined detections/pseudo-absences, present a narrow-predicted area of presence within the forest (Fig. 7). However, the model suggests possible habitat on the eastern side of the forest within the wildness area that was not surveyed. We attempted to get this area investigated through forest personnel entering the area for other projects, but that fell through. A qualitative evaluation of the forest inventory data available is consistent in suggesting that this is an area of potential occupancy by White-headed Woodpeckers (e.g., presence of ponderosa pine).

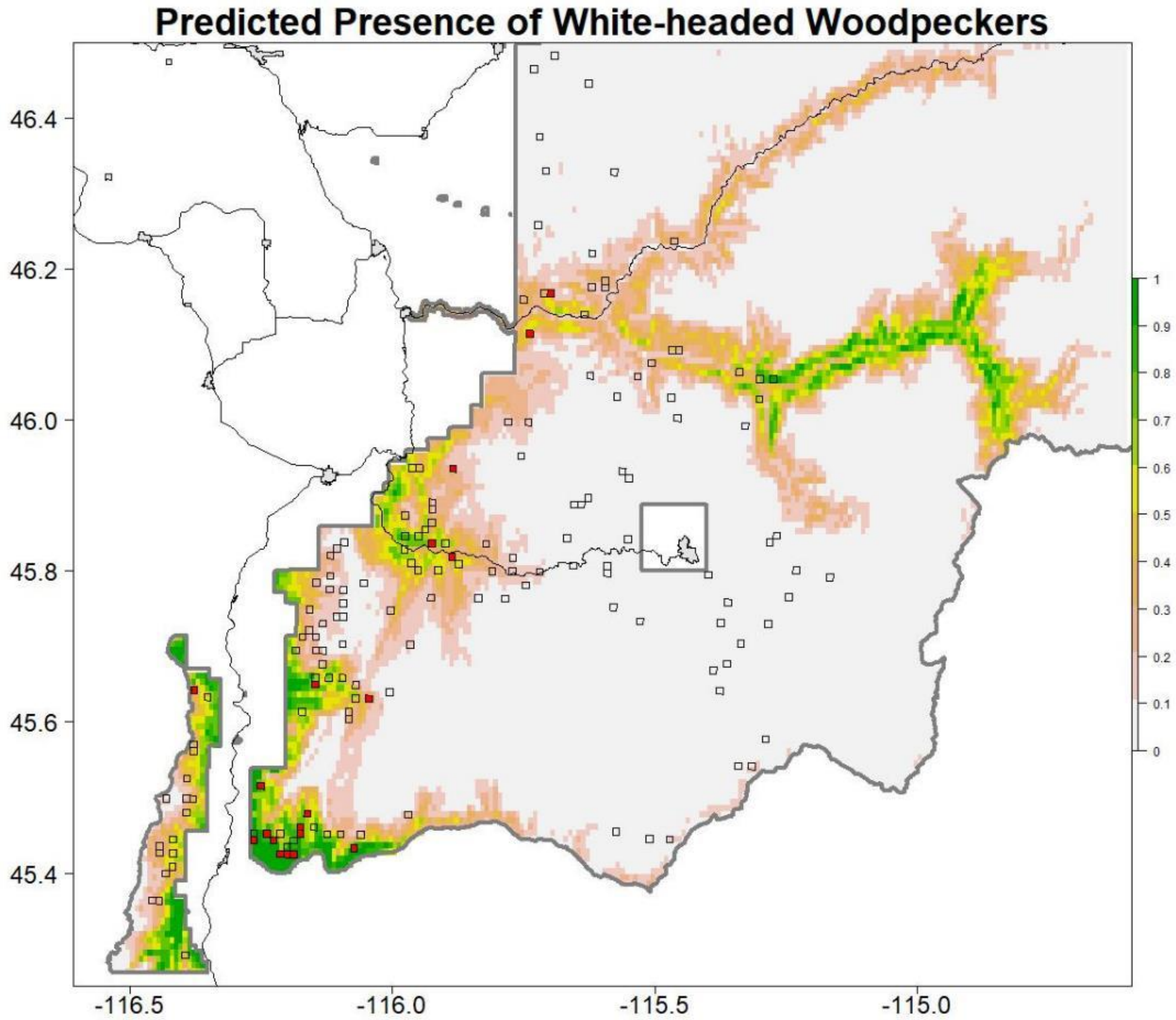

Figure 7. Completed White-headed Woodpecker surveys (squares) from 2016, 2017, and 2018, indicating presence (red) or no detection (hollow) overlaid on predicted White-headed Woodpecker distribution resulting from MaxEnt model combining results from 2016, 2017 and 2018. Omitted from view is a single detection in the Palouse District.

From a management perspective, these results emphasize the importance of the retention of ponderosa pine snags within the forest. The degree of agreement that our results have with previous studies and previous years of this program, helps to build confidence in our results. We suggest maintaining the 2017/2018 survey strata for future survey efforts to best measure any change in occupancy rates or any range expansion or contraction. However, a targeted survey effort within the wilderness on the east side of the forest may also be warranted based upon inventory and management objectives.

Pileated Woodpecker

We completed Pileated Woodpecker surveys on the same routes and points as White-headed Woodpeckers and all within the White-headed Woodpecker stratum. The White-headed Woodpecker stratum is very compatible with the expected habitat preferences of Pileated Woodpeckers. It is more restricted by favoring ponderosa pine but may have lower overall canopy cover as it favors locations with dense cover and local clearings. We did not survey the Pileated Woodpecker stratum in 2018. Pileated Woodpeckers were detected on survey at 90 points within 41 of the 56 surveyed grids (Fig. 8).

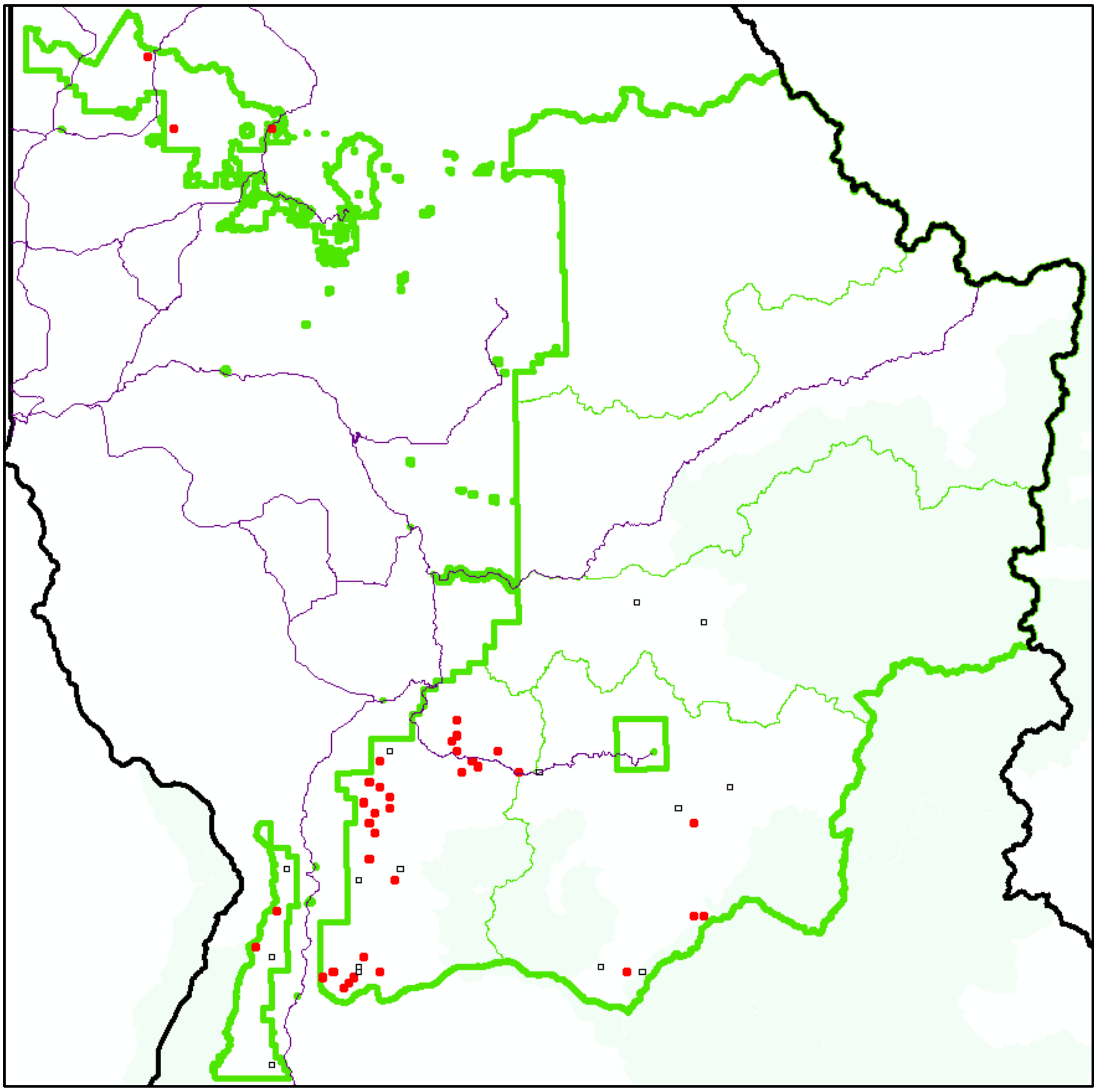

Figure 8. Completed woodpecker surveys within the Nez Perce - Clearwater National Forest during the 2018 Survey Season. Surveys without Pileated Woodpecker detections illustrated by open boxes, surveys with Pileated Woodpecker detections in red.

Within the multi-scale occupancy framework, we found survey type (silent/broadcast) to influence the probability of detecting at least one Pileated Woodpecker at a point given that there was at least one woodpecker at the point (*p*; Fig. 9). As expected, broadcast surveys were much more effective for detecting Pileated Woodpeckers as their vocal response and likelihood of approaching the surveyor is very high in response to call playback. This finding is consistent with most if not all other woodpecker surveys. The probability of detection increased from 0.13 during the silent period to 0.51 during the broadcast.

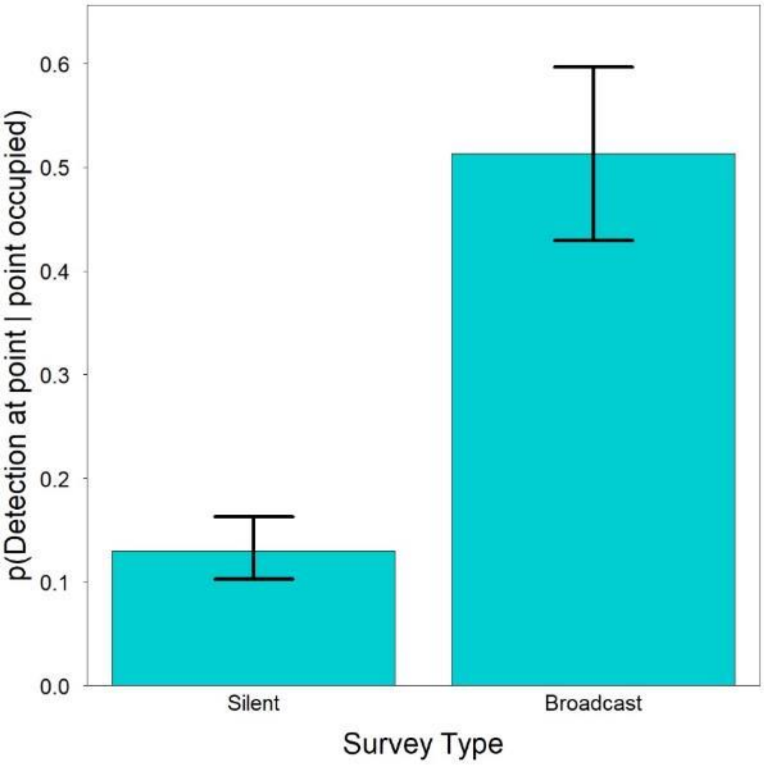

Figure 9. Covariates influencing the probability of detecting at least one Pileated Woodpecker at a point given that there was at least one Pileated Woodpecker at the point (p), represented with 95% confidence intervals.

We identified two variables influencing point-scale occupancy – the proportion of area around the point in Douglas fir and the canopy cover (Fig. 10). Douglas fir composition had a negative association with Pileated Woodpecker presence. This may be a side effect of the White-headed Woodpecker stratum. Canopy cover had a strong positive association with Pileated Woodpecker presence as expected.

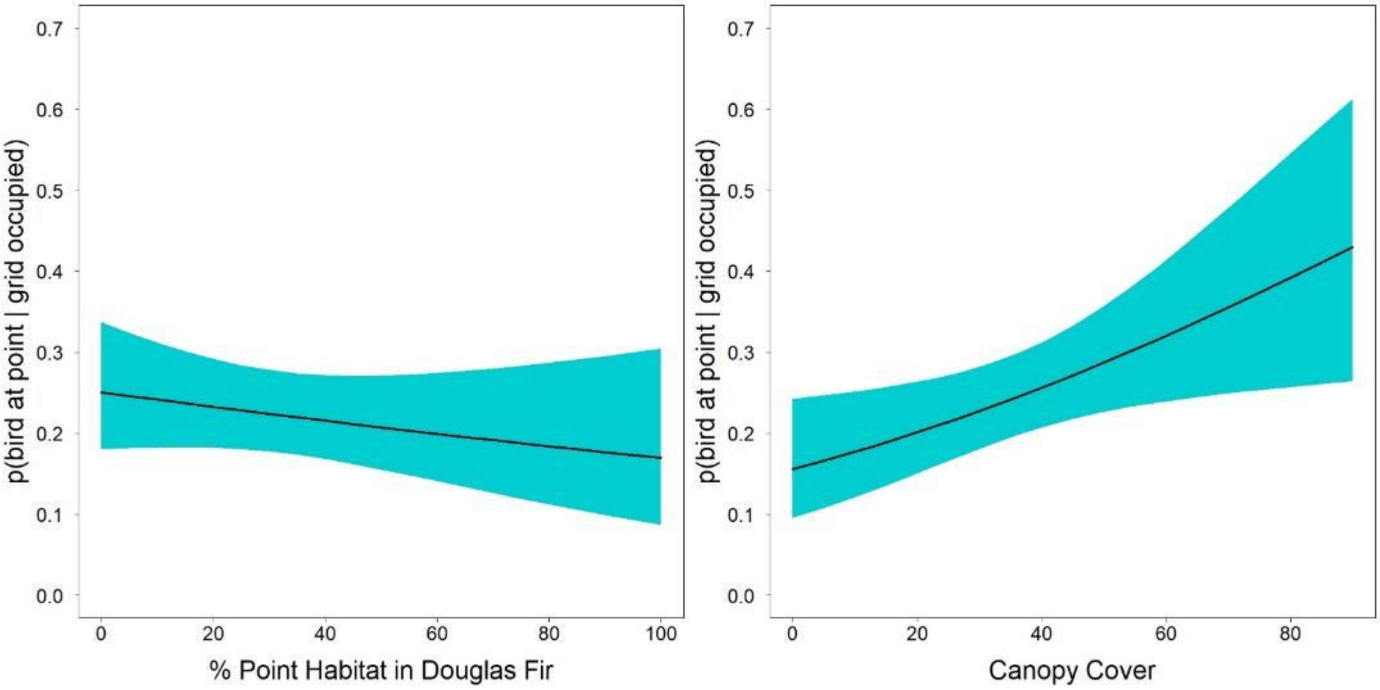

Figure 10. Covariates representing Douglas fir and canopy cover at a point predicting occupancy of the point by at least one Pileated Woodpecker given that at least one Pileated Woodpecker occupies the survey grid (Θ), represented with 95% confidence intervals.

In 2016, we found that Pileated Woodpeckers were associated with grids with a higher number of large snags available as would be expected for most woodpecker species. In 2017, the number of large snags just missed being selected within our model selection procedure (competitive, but did not overcome the penalty for adding additional variables). This year we found medium and larger snags as a positive predictor of

Pileated Woodpecker presence (Fig. 11), but large snags were also competitive. The snag indexes are all correlated with each other, thus the shift from one size to another among years is not entire unexpected.

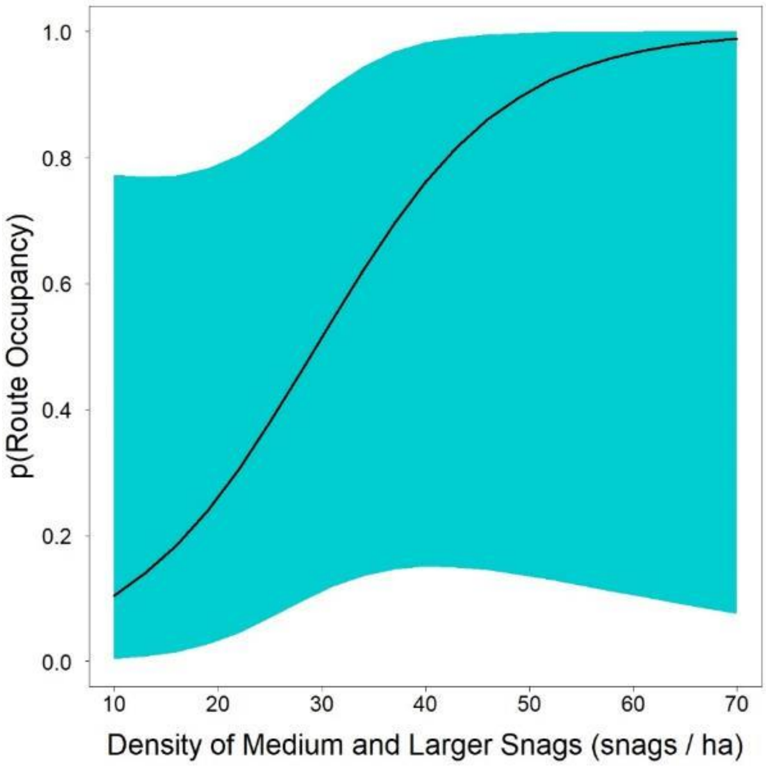

Figure 11. Predicted influence of snag density (medium and large snags) on the occupancy of the grid by Pileated Woodpeckers (Ψ), represented with 95% confidence intervals.

Using the top model, we calculated the probability of detecting a Pileated Woodpecker given that one was present (*p*) without call broadcast to be 0.13 ± 0.02 [95% CI: 0.10 – 0.16], and with call broadcast to be 0.51 ± 0.04 [95% CI: 0.43 – 0.60]. We calculated point-scale occupancy (i.e., availability; *Θ*) to be 0.23 ± 0.03 [95% CI: 0.18 – 0.28]. We calculated overall transect-scale occupancy (*Ψ*) by Pileated Woodpeckers to be 0.99 ± 0.00 [95% CI: 0.01 – 0.99]. The overall grid occupancy element for Pileated Woodpecker didn't work out this year. These raw numbers should be used with caution for this species as the model fitting routines had difficulty calculating the variance as we detected Pileated Woodpeckers too often. The estimated occupancy of 0.99 is higher than the two previous years of surveys.

In building the MaxEnt model for Pileated Woodpecker, the regularized training gain for the best fitting model (Linear/Quadratic with regularization parameter 1) built with all presence/pseudo-absence records from 2016, 2017 and 2018 was 0.08, and the AUC was 0.62. A good fitting model should have a AUC value above 0.70. Our AUC of 0.62 does not represent a good fit, so caution in interpretation of the results is advised. This situation is the likely result of two factors: 1) detecting too many Pileated Woodpeckers for modeling to distinguish between presence and pseudo-absence locations; and 2) not evaluating the appropriate factors that Pileated Woodpeckers use to settle in a given location.

From the jackknife test of variable importance, the single most important predictor variable, in terms of the gain produced by a one-variable model, was Canopy Cover (+), followed by Temperature Seasonality (-). Canopy Cover (+), followed by Mean Temperature of Driest Quarter (-) and Temperature Seasonality (-), decreased the gain the most when they were omitted from the full model, which suggests they contained the most predictive information not present in the other variables.

The MaxEnt model predictions for Pileated Woodpecker, built from the three years combined detections/pseudo-absences, present a broad predicted area of presence within the forest (Fig. 12) with Pileated Woodpeckers possible across most of the forest. This map should be used with some caution due to the weak model fit and the high density of point sampling within the WHWO stratum in the southwest portion of the forest.

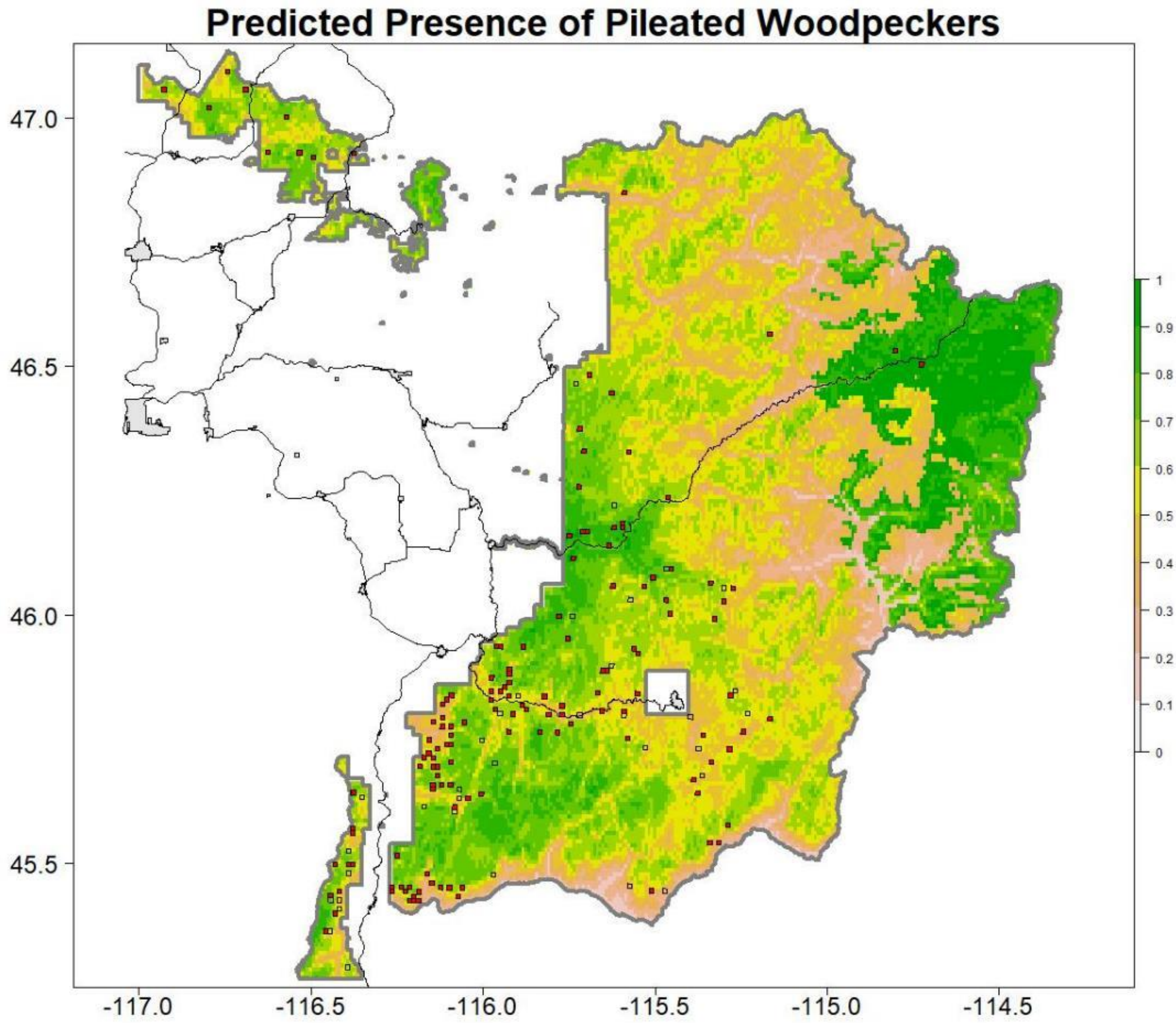

Figure 12. Completed Pileated Woodpecker surveys (squares) from 2016, 2017, and 2018, indicating presence (red) or no detection (hollow) overlaid on predicted Pileated Woodpecker distribution resulting from MaxEnt model combining results from 2016, 2017 and 2018. Model fit – predicting difference between presence and absence – was poor.

We suggest re-evaluating the priority of general monitoring of Pileated Woodpeckers across the Forest when they are so ubiquitous. A more focused evaluation of the impact of various management practices might be beneficial. However, the surveys in 2018 were essentially free as we dropped the Pileated Woodpecker stratum and surveyed for Pileated Woodpeckers at the same time and locations as the White-headed Woodpecker surveys.

In addition to the White-headed and Pileated Woodpeckers, we detected a number of other woodpecker species during formal surveys without performing species broadcasts. We detected three Lewis's Woodpeckers (*Melanerpes lewis*), 31 Williamson's Sapsuckers (*Sphyrapicus thyroideus*), six Red-naped Sapsuckers (*Sphyrapicus nuchalis*), one Downy Woodpeckers (*Picoides pubescens*), 87 Hairy Woodpeckers (*Picoides villosus*), three American Three-toed Woodpeckers (*Picoides dorsalis*), four Black-backed Woodpeckers (*Picoides arcticus*), and 153 Northern Flickers (*Colaptes auratus*).

Flammulated Owl

We surveyed for Flammulated Owls in a stratum containing landscapes composed of ponderosa pine and Douglas fir as dominant tree species. Using Forest Service VMAP data we restricted our stratum to forested landscape composed of PSME, PSME-IMIX, PIPO, and PIPO-IMIX habitat types, with a tree size greater than 6 inches Diameter at Breast Height (DBH) and canopy closure of less than 60%. We further removed candidate grids where more than 30% of the landscape had burned in the past three years. The final surveys were selected using the same spatially-balanced sampling as used for woodpeckers. At each survey point we implemented a ten-minute protocol consisting of a two-minute silent listening period followed by four two-minute broadcast/listen intervals (30 second broadcast followed by 90 second listen). We noted all intervals in which an individual bird was detected.

We performed surveys Flammulated Owls within 39 survey grids (1km × 1km). We completed 267 survey points located within the 39 survey grids and detected Flammulated Owls at 18 points within ten of the grids (Fig. 13).

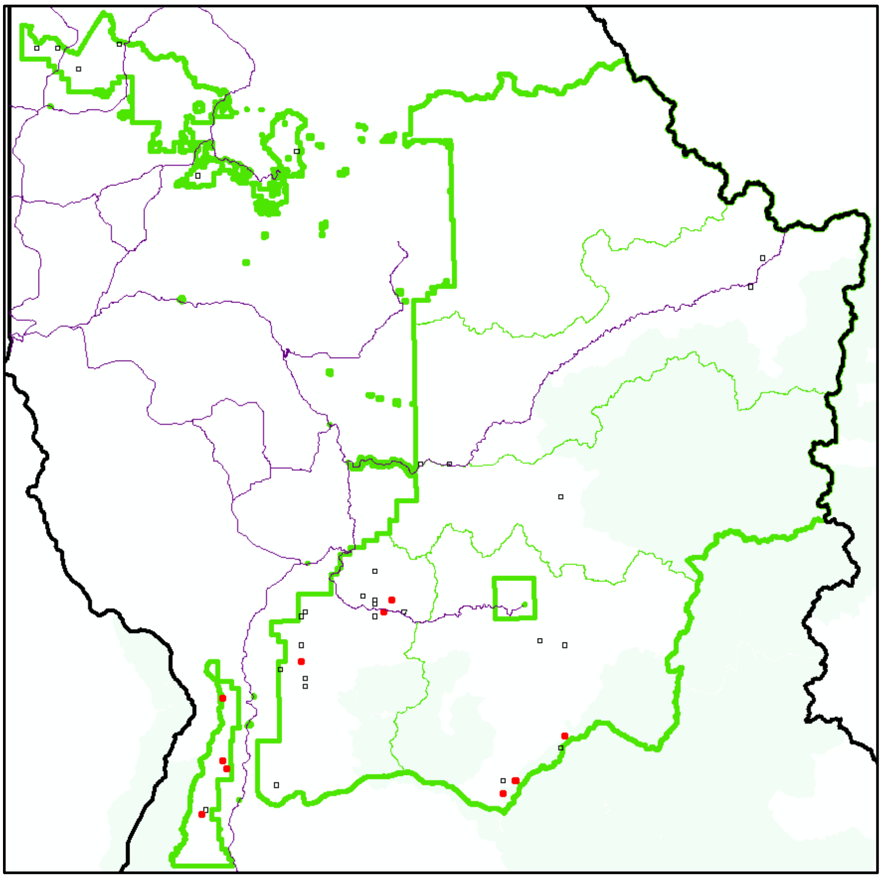

Figure 13. Completed Flammulated Owl surveys within the Nez Perce - Clearwater National Forest during the 2018 Survey Season. Surveys without Flammulated Owl detections illustrated by open boxes, surveys with Flammulated Owl detections in red.

Within the multi-scale occupancy framework, we found survey type (silent/broadcast) to influence the probability of detecting at least one Flammulated Owl at a point given that there was at least one owl at the point (*p*; Fig. 14). As expected, broadcast surveys were much more effective for detecting Flammulated Owls as their vocal response and likelihood of approaching the surveyor is very high in response to call playback. The probability of detection increased from 0.28 during the silent period to 0.66 during the broadcast.

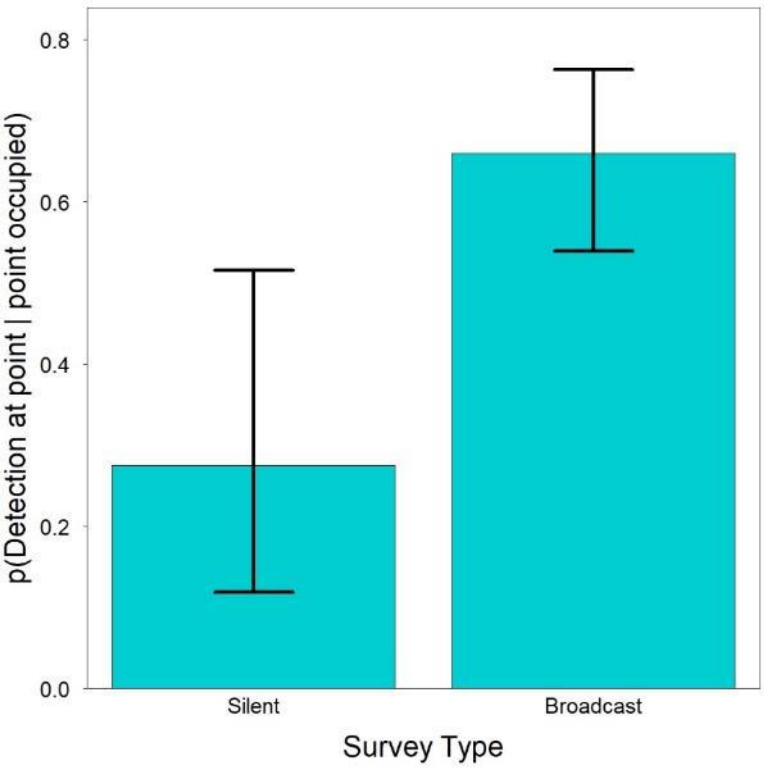

Figure 14. Influence of call broadcast on the probability of detecting at least one Flammulated Owl at a point given that there was at least one Flammulated Owl at the point (p), represented with 95% confidence intervals.

During the model selection process, we had no predictors falling above the null model predicting the presence of Flammulated Owls at a given point or on the survey grid. This may be the result of not testing the best data layers, the narrow definition of our survey stratum, or most likely, the result of small sample size. Using the top model (NULL except for survey type), we calculated the probability of detecting a Flammulated Owl given that one was present (p) without call broadcast to be 0.28 ± 0.10 [95% CI: 0.12 – 0.52], and with call broadcast to be 0.66 ± 0.06 [95% CI: 0.54 – 0.76]. We calculated point-scale occupancy (i.e., availability; Θ) to be 0.23 ± 0.06 [95% CI: 0.13 – 0.38]. We calculated overall transect-scale occupancy within the Flammulated Owl stratum (Ψ) to be 0.31 ± 0.09 [95% CI: 0.16 – 0.51]. The probability of encountering a Flammulated Owl within the stratum ($\Theta \times \Psi$) is 0.07.

Initial survey team during Flammulated Owl survey training. Left to right: Robert Miller, Gareth Dahlgren, Kara Snow, Steve Dougill, and Josie Braun. Not pictured were 2018 team members Victoria Thorpe, Carly Muench, and Adam Bradley. Photo: Kara Snow, May 8, 2018

In building the MaxEnt model for Flammulated Owls, the regularized training gain for the best fitting model (Linear/Quadratic with regularization parameter 1.0) built with all presence/pseudo-absence records from 2018 was 0.33, and the AUC was 0.78. A good fitting model should have an AUC value above 0.70. Our AUC of 0.78 suggests good model fit. From the jackknife test of variable importance, the single most important predictor variable, in terms of the gain produced by a one-variable model, was Precipitation Seasonality (-), followed by Precipitation of Wettest Quarter (-), Precipitation of Wettest Month (-), Canopy Cover (-), and Tree Size (+). Tree Size (+), followed by Canopy Cover (-), and Precipitation Seasonality (-), decreased the gain the most when they were omitted from the full model, which suggests they contained the most predictive information not present in the other variables.

The MaxEnt model predictions for Flammulated Owl, built from the 2018 detections/pseudo-absences, present a broad predicted area of presence within the forest (Fig. 15) with Flammulated Owls possible across most of the forest.

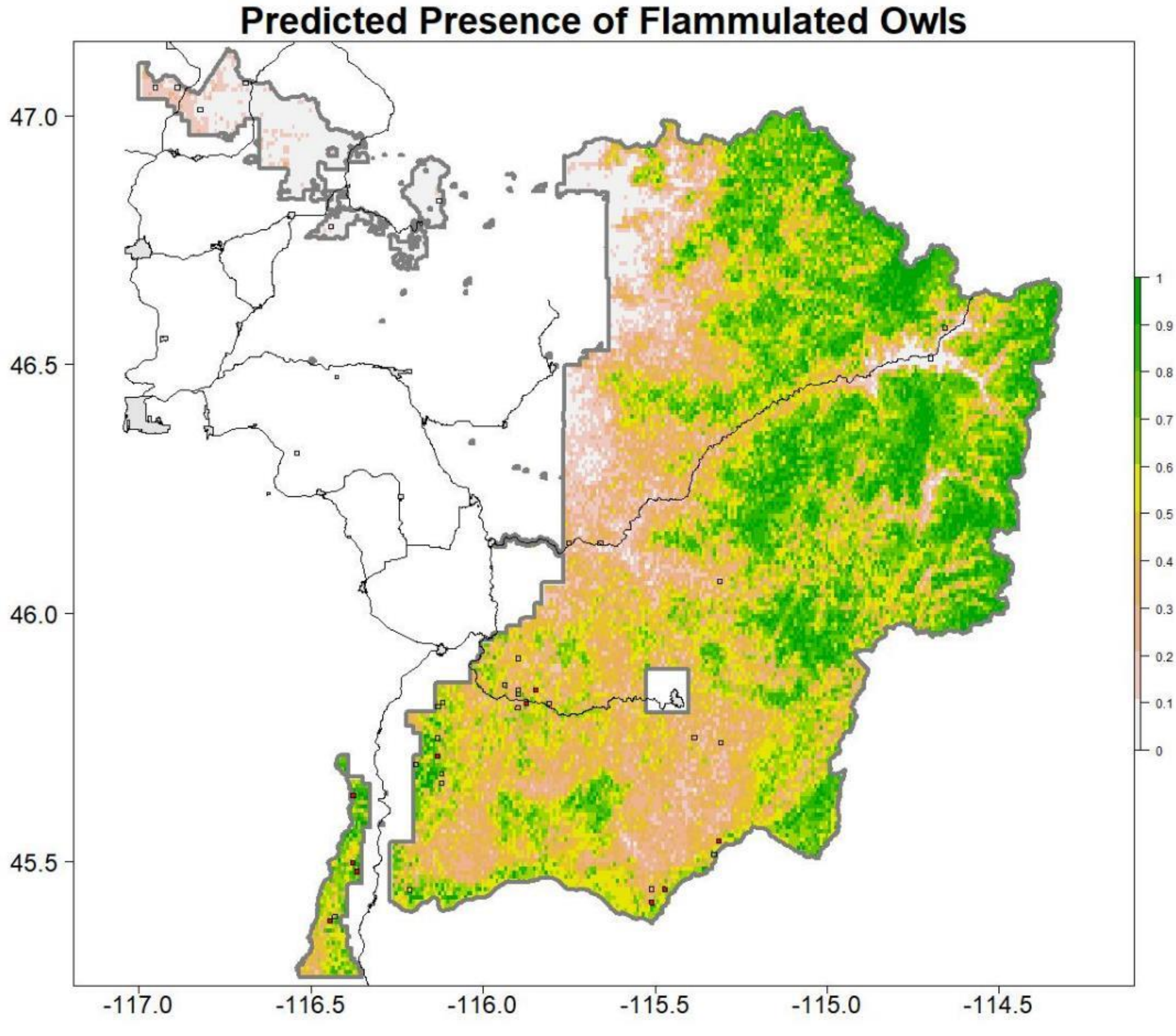

Figure 15. Completed Flammulated Owl surveys (squares) from 2018, indicating presence (red) or no detection (hollow) overlaid on predicted Flammulated Owl distribution resulting from MaxEnt model. Model fit – predicting difference between presence and absence – was good.

The negative association with canopy cover came as a surprise. Some studies have found weak positive association with canopy closure for nest sites (Scholer et al. 2014). However, we had a positive influence with tree size, suggesting that larger trees and lower cover might favor this species. McCallum and Gehlbach (1988) have found the canopy height was a more important predictor than canopy cover, which domewhat supports our results. We suggest maintaining the 2018 survey stratum for future survey efforts to best measure any change in occupancy rates. An increase in the number of samples across the forest would provide better habitat associations that might better inform management actions.

In addition to Flammulated Owls, our team recorded observations of all owl species detected during formal surveys. We detected ten Great Horned Owls (*Bubo virginianus*), two Northern Pygmy-Owls (*Glaucidium gnoma*), 11 Barred Owls (*Strix varia*), one Great Gray Owl (*Strix nebulosa*), and 12 Northern Saw-whet Owls (*Aegolius acadicus*).

Northern Goshawk

We implemented two Northern Goshawk projects within the Forest. The first project was a random spatially-balanced survey across the forest with the intention of establishing statistically-rigorous occupancy rates among years and for comparison to the 2005 region-wide survey (Kowalski 2005). The second project involved checking the occupancy status of a select group of historical nesting locations and if found unoccupied, surveying the immediate vicinity of historical nest structures.

Spatially-balanced Survey

We stratified the forest for Northern Goshawk surveys by choosing forest areas with higher canopy cover (>40%), larger trees (>10 inch DBH), lower slope (<50%), with aspects other than south or southwest, and primary tree species not sub-alpine fir (Reynolds et al. 1982, Younk and Bechard 1994, Finn et al. 2002, La Sorte et al. 2004, Miller et al. 2013). The stratum definition for spatially-balanced goshawk surveys has remained unchanged since 2016, but we chose new sampling grids each year in the hopes of finding goshawks in areas where they were not previously known to be present.

We surveyed for Northern Goshawks at 450 survey points within 57 randomly selected survey grids (1km × 1km; randomly selected from within our defined goshawk stratum). We detected goshawks on 11 of the 57 survey grids (Fig. 16; Table 3).

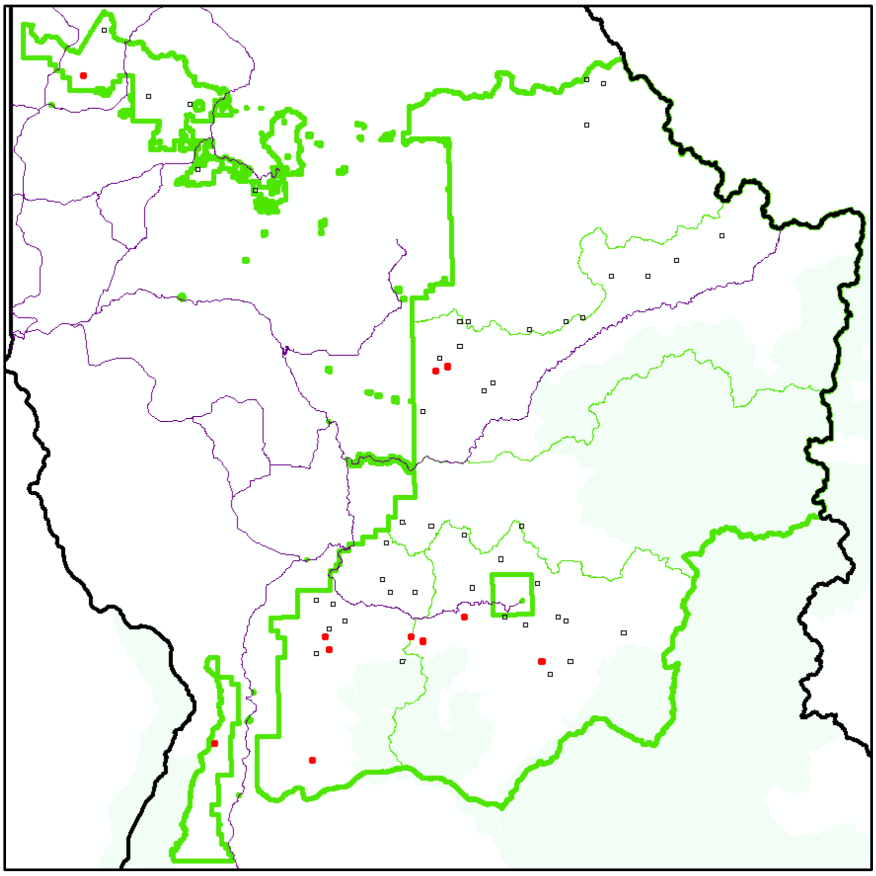

Figure 16. Completed spatially-balanced Northern Goshawk surveys within the Nez Perce - Clearwater National Forest during the 2018 Survey Season. Surveys without Northern Goshawk detections illustrated by open boxes, surveys with Northern Goshawk detections in red.

Clearwater River. Photo Steve Dougill, May 14, 2018.

Table 3. Observations of Northern Goshawks detected during survey effort, excluding historical nest check areas (reported later in this document). Note, unlike woodpecker and Flammulated Owl surveys, broadcasts for goshawks ceased after first detection on a route.

Route, Point	Date	UTM Zone	UTM Northing	UTM Easting
NOGON-12,7	7/17/2018	11	5133167	603167
NOGON-13,4	7/17/2018	11	5204500	514167
NOGON-60,3	7/16/2018	11	5132833	600833
NOGON-64,7	7/19/2018	11	5071500	632167
NOGON-68,5	7/20/2018	11	5061500	626500
NOGON-76,5	7/19/2018	11	5066500	597500
NOGON-86,4	7/18/2018	11	5072500	607167
NOGON-87,2	7/19/2018	11	5067833	594500
NOGON-88,3	7/18/2018	11	5064833	574833
NOGON-93,6	7/17/2018	11	5067500	573833
NOGON-99,2	7/13/2018	11	5041833	546500

We evaluated several detection and habitat variables within our multi-scale occupancy framework including time-of-day, day-of-year, canopy cover, tree size, elevation, slope, and aspect. No variables were chosen as impacting occupancy of a given area by goshawks. This is likely the result of a very narrow stratum definition using many of these same variables, combined with the low number of detections during the survey.

Using the NULL model, we calculated the probability of detecting at least one goshawk at a point given that there was at least one goshawk at the point (p) using broadcast, to be 0.75 ± 0.08 [95% CI: 0.56 – 0.87]. This probability of detection compares favorably with Woodbridge and Hargis (2006). We calculated the probability of at least one goshawk being at a point given that there was at least one within the grid (Θ), to be 0.22 ± 0.10 [95% CI: 0.08 – 0.48]. We calculated the probability of a given grid within our stratum being occupied by at least one goshawk (Ψ), to be 0.22 ± 0.07 [95% CI: 0.12 – 0.38]. Our estimate occupancy rate is nearly identical to the 2017 estimate. The confidence intervals are wider due to a fewer number of samples in 2018 (Fig. 17).

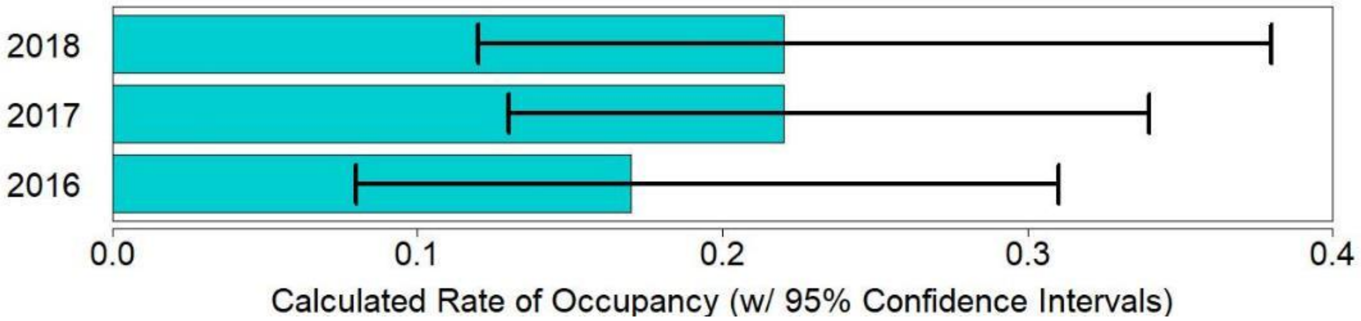

Figure 17. Calculated rate of 1km × 1km grid occupancy by Northern Goshawks within the selected survey stratum among years, each illustrated with 95% confidence intervals.

Kowalski (2005) performed goshawk surveys across the U.S. Forest Service Region 1 forests in 2005, including the NPCNF. Kowalski (2005) reported an estimated occupancy rate of 0.39 [95% CI: 0.29-0.50]. This rate is based upon a 697-ha survey grid randomly placed within forest lands. Our survey grids are smaller (i.e., expect lower occupancy rate) and placed in higher quality habitat (i.e., expect higher occupancy rate) and thus the numerical occupancy rates cannot be directly compared. We selected smaller grids in higher quality habitat to increase the distribution of land surveyed, to ensure we had an adequate sample size of grids with our level of investment, and to increase the chance of detecting previous unknown goshawk territories.

While we were not able to directly compare the occupancy numbers, we were able to simulate the spatial relationship between the two rates for indirect comparison (He and Condit 2007). Assuming that goshawk territories are randomly placed across a landscape with an assumed occupancy of 0.17 per 100 ha (our 2016 results), scaling up to the 697-ha sampling grid of Kowalski (2005) would produce a comparable occupancy rate of 0.67 ± 0.01. The calculation based upon 2017 and 2018 results would produce an estimated comparable occupancy rate of 0.77 ± 0.01. These rates are considerably higher than the 0.39 estimated by Kowalski (2005) for two reasons: 1) goshawks territories are probably not randomly placed on the landscape as habitat is not random on the landscape (a clumped distribution would generate a lower occupancy rate when scaling up, but probably not by the margin reported [He and Condit 2007]); and 2) we surveyed higher quality habitat on average than Kowalski (2005). Qualitatively, our three years of results appear to support a conclusion that the Northern Goshawk is still doing well within the forest.

While the current program does not allow for direct comparison to Kowalski (2005), the current level of investment is not sufficient to produce a statistically rigorous program that would be directly comparable. We therefore recommend that we continue with the current program and stratum definition, and track changes in occupancy rates as we move forward. Moving to a random survey across forest lands would bring us closer to a direct comparison with Kowalski (2005), but would also decrease the number of detections and weaken any occupancy rates we can produce.

In building the MaxEnt model for Northern Goshawk, the regularized training gain for the best fitting model (Linear/Quadratic with regularization parameter 1.0) built with all presence/pseudo-absence records from 2016, 2017, and 2018 was 0.24, and the AUC was 0.72. This represents a moderate. From the jackknife test of variable importance, the single most important predictor variable, in terms of the gain produced by a one-variable model, was canopy cover (+), followed by Isothermality (+), Mean Temperature of Wettest Quarter (-) and Mean Temperature of Coldest Quarter (+). Canopy cover (+), followed by Mean Temperature of Wettest Quarter (-) decreased the gain the most when they were omitted from the full model, which suggests they contained the most predictive information not present in the other variables.

The distribution map resulting from the MaxEnt analysis may be useful in future project evaluation, even though the fit was weaker than we had hoped (Fig. 18). The geographic influences represented in the

MaxEnt model are consistent with most other studies of Northern Goshawks (e.g., Finn et al. 2002, La Sorte et al. 2004, Miller et al. 2013). The climate influences are somewhat difficult to isolate as many are highly correlated, but the combined features would be expected to produce the mature forest structure upon which goshawks most often depend.

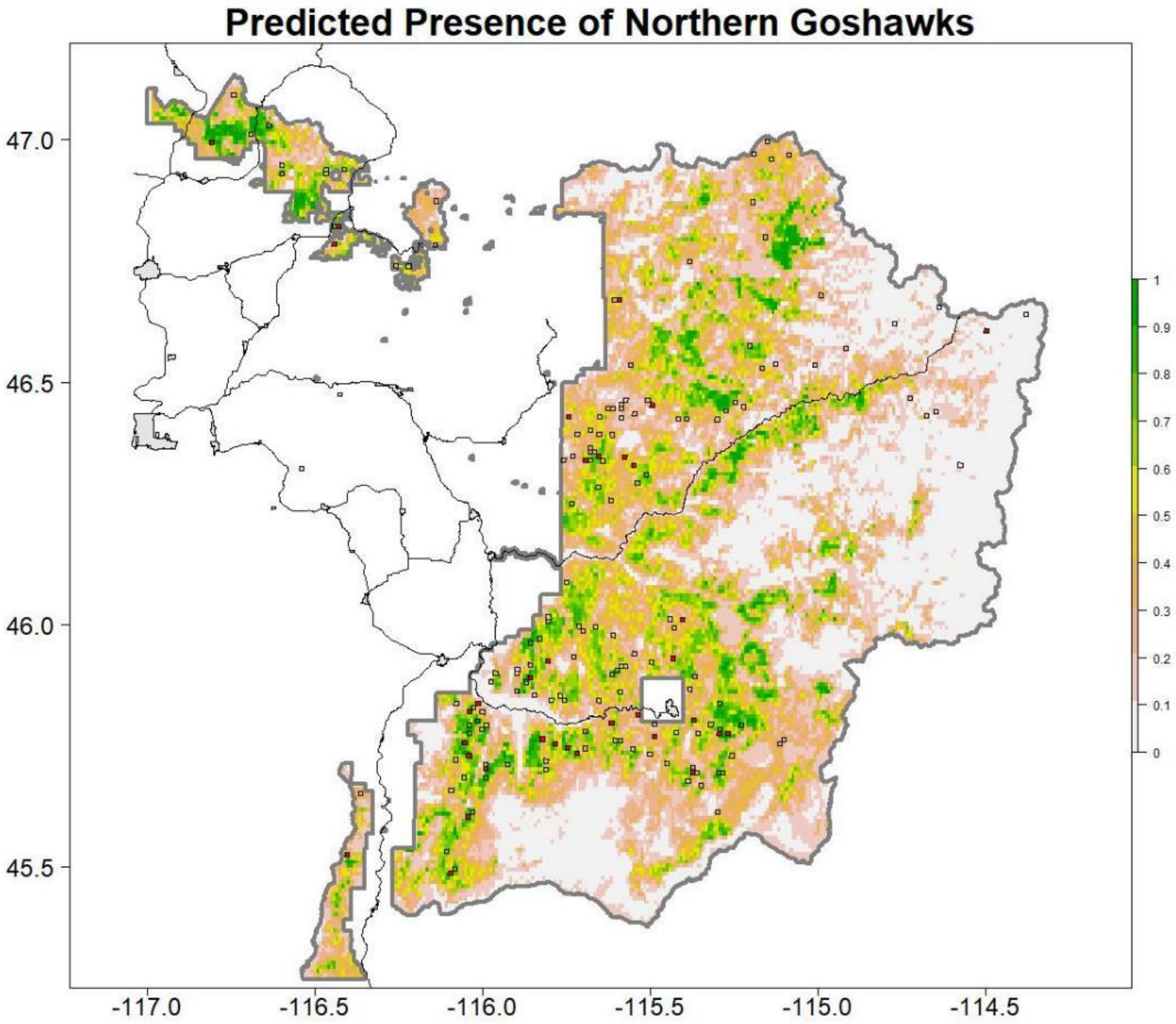

Figure 18. Completed Northern Goshawk surveys (squares) from 2016, 2017, and 2018, indicating presence (red) or no detection (hollow) overlaid on predicted Northern Goshawk distribution resulting from MaxEnt model. Model fit – predicting difference between presence and absence – was moderate.

Historical Nest Checking

The IBO team was contracted to check the status of 20 historical goshawk territories within the Nez Perce – Clearwater National Forest. We visited 30 historical nest structures located within the 20 historical goshawk nesting territories to check the occupancy status of the structures, to search for new nest structures in the area, and to survey for goshawks within the area using a standard survey protocol (Woodbridge and Hargis 2006).

Nest checking and surveying efforts produced observations, or lack thereof, that fit into a territory status model as proposed by Woodbridge and Hargis (2006). Note: these are territory status classification, not nest status classifications. We assigned values of “No Detection”, “Presence”, “Occupancy”, and “Breeding”. In some cases, we could confirm failure or success in areas where breeding was confirmed. “No Detection” should not be considered equivalent to “Not Occupied” as our survey protocol is only estimated to be 70%

effective in detecting goshawks in an area. “Presence” indicates that a bird was observed in the area on one occasion, but no evidence of breeding. “Occupied” is assigned to territories where a bird was observed on at least two occasions, or a single bird was observed with evidence of nest orientation (perched at nest, fresh greenery on nest, molted feathers on ground near a nest, etc.). Occupied does not imply that a pair of birds were present, only that at least a single bird was committed to the area (e.g., male goshawk defending a territory and looking for a mate). “Breeding” indicates the nest was still successful at the time of our surveys, but the nestlings had not yet reached an age of 34-days where we could classify the nest as “Successful”. “Breeding-Failed” indicates that there is evidence of a breeding attempt in the current year, but that attempt had failed prior to our last visit to the area. In a few cases, we were able to conclude “Breeding – Success” as the young were observed at an age of at least 34-days old or observed outside of the nest (Woodbridge and Hargis 2006).

We received a prioritized list of historical territories from the NPCNF. We checked historical nest structures if they could be found and then performed call broadcasts around the historical nest structures and at points spread 300m apart (Woodbridge and Hargis 2006), covering all area extending out to 500m from the structures. To ensure that all habitat out to 500m from the historical nest structure fell within 200m of a survey point, a minimum of 13 call points was established per territory, more when multiple historical nest structures were known.

Photo: Victoria Thorpe, July 17, 2018.

Northern Goshawks were detected in 11 of the 20 territories that we monitored (Table 4). Due to the timing of our nest checking we were unable to conclude if breeding was successful or not, so the status of nests is listed as “Unknown fate”. To classify a breeding attempt as “Successful” requires the observation of fledglings or of nestlings at least 34-days-old (Woodbridge and Hargis 2006). During our survey work we discovered both occupied and unoccupied nest structures believed to have been built by goshawks (Table 5).

Table 4. 2018 status of historical Northern Goshawk territories within the Nez Perce – Clearwater National Forest, classified per Woodbridge and Hargis (2006).

Status	Territory	
No detection	Big Canyon Creek	D04-01
	Dry Fork	East Fork Goose Creek
	French Creek	Kelly Work Center
	Little Bald Mountain	Poorman Creek
	White Pine Creek	
Presence	American Creek	Center Ridge
	D01-05	Hem Creek
	Merton Creek	Pistol Grip Mine
Occupied	Lowell	
Breeding – Unknown fate	Crooked River	D01-02A
	Papoose Creek	SF Whitebird Creek

Table 5. New nest structures discovered during goshawk surveys. All nest structures believed to have been built by goshawks.

Territory	Occupied	Zone	Easting	Northing	Tree Species	DBH	Height	Canopy Closure	Understory Density†
American Creek	No	11	582397	5066590	DF	18in	25m	65%	2
Merton Creek	No	11	580439	5062621	GF	6-16in	20m	70%	3
Crooked River	No	11	574800	5074543	GF	20in	25m	60%	1
Crooked River	Yes	11	574604	5074523	GF	25in	30m	60%	1
Whitebird Creek	Yes	11	569603	5068308	DF	18in	25m	60%	1

†Understory Density: 1=360° flight access, ground access; 3=flight access from many directions, some ground access; 5= No under-canopy flight access (i.e., not viable).

Conclusions

Our team faced a few challenges in 2018 related to staffing issues that affected the sample size we were able to acquire for some of the target species. We had an employee quit for family reasons and another that was involved in a roll-over accident and was medically unable to return (she has since fully recovered). We brought in additional resources late in the season but were unable to make up the difference for all species. However, we did get sufficient samples to consider the project a success.

The White-headed Woodpecker surveys further refined our prediction models across the forest, and once again identified potential habitat on the eastern side of the forest where further populations might exist. We recommend a focused survey in that area to determine if birds are present. We estimated a lower occupancy of White-headed Woodpecker this year as compared with last, although the decrease was not statistically significant. Regardless, this possible decrease does warrant further investigation in future years.

Pileated Woodpeckers continue to be ubiquitous in the forest. We detected so many that our analyses suffered from a lack of absence points to produce a high-quality result. A lack of absence points operates much the same way as a lack of detection points. While we were not able to provide strong quantification for this species, we are comfortable concluding that their population is doing well. We would recommend continuing to monitor for Pileated Woodpeckers if it can be done very inexpensively such as our program of combining surveys with White-headed Woodpeckers. However, an annual program focused solely on Pileated Woodpeckers is probably not justified unless there are specific project questions to be evaluated.

This was our first year of surveys for Flammulated Owls within the Nez Perce-Clearwater National Forest. The sample size for this species was smaller as it is a much more expensive program to implement. Our crew works in teams of two at night, verses the other diurnal species surveys that are performed solo. We were constrained by the previously mentioned staffing issues and for much of the season we had an odd number of people working in the forest (less flexibility to perform Flammulated Owl Surveys). We were pleased with the number of detections we had of Flammulated Owls for the number of surveys we completed (10 of 39 completed surveys). The number of surveys with owls appeared on the upper edge of the range we expected (20 – 25%) based upon our experience in other forests (e.g., Sawtooth National Forest). We have now established an occupancy rate for the forest for future comparisons and a good fitting prediction model.

The random surveys for Northern Goshawks produced an estimate nearly identical to 2017 suggesting that the population in the forest was stable between these two seasons. The estimate was non-significantly higher than 2016. While performing these surveys we detected goshawks in 11 areas where they had not previously been reported. This continues to expand the forest-wide data on goshawk distribution. As for historical goshawk surveys, we trained our crew and the forest service crew on a consistent technique, and report the results of our survey work so that it may be integrated with the rest of the Forest Service collected data for a comprehensive view.

Based upon our set of results we have made some management recommendations and recommendations regarding the structure of these monitoring programs moving forward. In all cases, except for White-headed Woodpeckers, we recommend the 2018 strata definitions me maintained in future years. The stratum definition for White-headed Woodpeckers should be maintained in the southwest portion of the forest, but a wilderness survey in the east should be considered. IBO remains committed to working through these recommendations with the staff of the NPCNF.

Acknowledgements

We thank the Nez Perce – Clearwater National Forest for funding this effort. We further acknowledge the hard work and dedication exhibited by the survey team – they remained professional, focused, and committed, through the long survey season and diversity of challenging conditions and situations.

The Salmon River on the final day of the season. Photo: Josie Braun July 19, 2018.

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Appendix I: Datasheets

BOISE STATE UNIVERSITY
INTERMOUNTAIN BIRD OBSERVATORY

Nez Perce Clearwater Woodpeckers 2018 Page ___ of ___

Transect:___________________________ Date:_________________ Observer:_________________________________

Start P1:_____ Wind:___ Sky: ______ Temp:____°F Noise:____ Start P2:______ Wind:___ Sky: _____ Temp:___°F Noise:____

Start P3:_____ Wind:___ Sky: ______ Temp:____°F Noise:____ Start P4:______ Wind:___ Sky: _____ Temp:___°F Noise:____

Start P5:_____ Wind:___ Sky: ______ Temp:____°F Noise:____ Start P6:______ Wind:___ Sky: _____ Temp:___°F Noise:____

Start P7:_____ Wind:___ Sky: ______ Temp:____°F Noise:____ Start P8:______ Wind:___ Sky: _____ Temp:___°F Noise:____

Start P9:_____ Wind:___ Sky: ______ Temp:____°F Noise:____ (Wind: 0 - 7; Sky: 0 - 4; Noise: 0 - 4)

Point # *	Species	Initial Dist.	Bearing	Min. Dist.	Time Interval (Check all intervals)**										Visual Y / N	Age / Sex	Comments
					Silent						WHWO		PIWO				
					1	2	3	4	5	6	1	2	1	2			

*One line per individual bird observed (ALL woodpecker species). **Six 1 minute intervals of silent, followed by two 1 minute intervals of broadcasts for each species

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INTERMOUNTAIN BIRD OBSERVATORY

Nez Perce Clearwater Surveys 2018 – Veg (WP and FLOW)

Transect:____________________ Date:________________ Observers:________________________________

						Overstory (% must total to 100%)									
Point	Cliff/ Rock	# Snags	Primary Habitat	Canopy Cover	Mean Canopy Ht	Spec #1	Spec 1 %	Spec #2	Spec 2 %	Spec #3	Spec 3 %	Spec #4	Spec 4 %	Spec #5	Spec 5 %
1															
2															
3															
4															
5															
6															
7															
8															
9															

	Understory (Spec totals must equal 100%)											
Point	Cover %	Mean Height (m)	Spec #1	Spec 1 %	Spec #2	Spec 2 %	Spec #3	Spec 3 %	Spec #4	Spec 4 %	Spec #5	Spec 5 %
1												
2												
3												
4												
5												
6												
7												
8												
9												

	Ground Cover (must total 100%)							
Point	% Snow	% Water	% Woody	% Dead Down	% Herbacious	% Bare Litter	% Dead Grass	% Live Grass
1								
2								
3								
4								
5								
6								
7								
8								
9								

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INTERMOUNTAIN BIRD OBSERVATORY

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Nez Perce Clearwater Surveys 2018 – Snags (WP and FLOW)

Transect:_____________________ Date:_________________ Observers:___________________________________

Point # *	Species If known	Distance (meters)	DBH Class Inches (circle)	Height class (circle)	% Bark (nearest 10%)	# Visible cavities
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		

* One line per individual snag visible from the survey point. Measure with rangefinder. Species codes: AS, LP, DF, GF, WP,…

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INTERMOUNTAIN BIRD OBSERVATORY

Nez Perce Clearwater Flammulated Owl 2018 Page ___ of ___

Transect:____________________________ Date:_________________ Observer:_________________________________

Start P1:_____ Wind:___ Sky: ______ Temp:____ °F Noise:____ Start P2:______ Wind:___ Sky: _____ Temp:___ °F Noise:____

Start P3:_____ Wind:___ Sky: ______ Temp:____ °F Noise:____ Start P4:______ Wind:___ Sky: _____ Temp:___ °F Noise:____

Start P5:_____ Wind:___ Sky: ______ Temp:____ °F Noise:____ Start P6:______ Wind:___ Sky: _____ Temp:___ °F Noise:____

Start P7:_____ Wind:___ Sky: ______ Temp:____ °F Noise:____ Start P8:______ Wind:___ Sky: _____ Temp:___ °F Noise:____

Start P9:_____ Wind:___ Sky: ______ Temp:____ °F Noise:____ (Wind: 0 - 7; Sky: 0 - 4; Noise: 0 - 4)

Point #*	Species	Initial Dist.	Bearing	Min. Dist.	Detections**					Comments
					S1	B2	B3	B4	B5	

*One line per individual bird observed. **one 2 minute interval of silence, followed by four 2 minute intervals of broadcasts.

Nez Perce Clearwater Northern Goshawk 2018

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INTERMOUNTAIN BIRD OBSERVATORY

Transect:____________________________ Date:__________________ Observer:___________________________________

Point	Time 24 hour	Wind 0 - 7	Sky Clear, PC, MC, Cloud	Temp F	Interval			Bearing	Init. dist.	Notes
					1	2	3			
1										
2										
3										
4										
5										
6										
7										
8										
9										

- Discontinue survey after detection. Search for nest for <u>at least</u> two hours. Can repeat broadcast at another point to help triangulate location, but best if wait for 30 minutes (call fatigue…). Make notes on zoomed in TOPO map.